

VIDEO DISPLAY TERMINAL GUIDELINES

Public Employees Occupational Safety and Health Program
New Jersey State Department of Health and Senior Services

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INTRODUCTION

The State of New Jersey and its local government agencies are becoming increasingly dependent upon video display terminals (VDTs), which have the potential to increase workplace productivity and efficiency. Yet VDTs have often been introduced without a plan to ensure comfort, safety and knowledge of good work practices among VDT operators. Studies have shown that improvements in VDT workstations can increase productivity dramatically (9). Productivity can decrease, however, if VDTs are introduced without well-designed workstations, training and attention to conditions of work (9).

These Guidelines are being issued by the New Jersey Department of Health and Senior Services (NJDHSS) Public Employees Occupational Safety and Health (PEOSH) Program to help managers provide VDT operators with workstations with well-designed lighting, furniture and equipment, as well as with training and vision care. Successful implementation will help avoid the health problems described below and increase operator satisfaction and productivity. The Guidelines are also intended as an educational tool for managers and employees regarding adverse health effects of poor VDT workplace design and recommended improvements.

The Guidelines include recommendations on VDT workstations and VDTs themselves, which will aid managers in purchasing new equipment. Vision examinations are also addressed, so that VDT operators may have visual problems corrected as quickly as possible. Training is included in the recognition that it is important to sensitize managers to the nature and importance of healthy VDT working conditions. It is also important to train operators in the use of adjustable furniture, in good work practices which minimize the potential adverse health effects of VDT work, in early signs of health effects such as carpal tunnel syndrome, and in information they should bring to their eye doctors. Finally, breaks and job design recommendations are included to indicate appropriate work-rest schedules to minimize the stresses of VDT work.

Flexibility of the Guidelines

Your feedback on these Guidelines from your experiences implementing them in the workplace will be invaluable in revising and refining them. Please address your comments to the PEOSH Program, New Jersey Department of Health and Senior Services, CN 360, Room 701, Trenton, NJ 08625-0360.

What the Guidelines Do

The Guidelines recommend methods to reduce excessive light and glare from VDT workstations, thereby reducing eyestrain. Vision exams will ensure that operators who need them have appropriate corrective lenses for VDT work, also reducing eyestrain. In addition, reducing reflections in the screen will reduce the need of operators to contort their bodies in order to read the display, thereby reducing muscle strain as well as eyestrain.

The Guidelines also explain how to design flexible, ergonomically appropriate VDT workstations, with chairs and tables which permit optimal postures and allow operators to change postures during prolonged periods of VDT work. These measures will reduce the likelihood of muscle strain and repetitive strain injuries, such as carpal tunnel syndrome.

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Training will teach VDT operators to adopt work practices that minimize adverse effects of VDT work. They will learn optimal postures, keying techniques, furniture adjustments and exercises. In addition, they will learn what information regarding VDT specifications and working distances should be given to the eye doctor to make maximal use of their eye examination.

The Guidelines address psychological stress and its adverse physical and mental effects, with recommendations on job task variety, breaks and autonomy. Regular and discretionary breaks and reduced hours of VDT work daily will help reduce mental and physical health effects of VDT work.

Scope of the Guidelines

The scope of these Guidelines varies with issues addressed, and so is considered separately in different sections. The Guidelines recognize that all VDT workstations should be correctly designed. Thus, the sections on VDTs and VDT equipment apply not to a specified group of operators, but to all newly purchased equipment and to existing workstations on a prioritized basis. Sections requiring specific services for VDT operators (training and vision examinations) include all operators who do VDT work for 10 or more hours per week. In these sections, it is recommended that provisions be implemented on a prioritized basis. Services should be offered first to those operators doing the greatest number of hours of VDT work, those doing the most intensive VDT work and those experiencing symptoms.

Health Effects of VDT Work

Various health problems have been associated with the use of VDTs, including visual problems, muscle aches and pains, repetitive trauma injuries (such as carpal tunnel syndrome) and job stress. In addition, questions have been raised about reproductive risks and about the effects of low-frequency radiation. Reviews of VDT health effects are included in the REFERENCES (1 - 4).

Visual problems are the most frequent complaint reported by VDT operators. Symptoms include eye discomfort, eyestrain, burning, itching, irritation, blurred distance vision and aching. Other less frequently reported symptoms include double vision, color fringes and reported deterioration of the ability to see fine detail. Severe eye discomfort may not go away within a short period of time following work and may even be present at the start of the next day's shift. Data suggest that some types of VDT work produce greater levels of visual complaints than traditional office work, because of the special visual demands of VDT work.

Prolonged attention to visual detail with limited eye movement in a restricted visual field can cause eyestrain and other problems. Tasks which require an operator to look back and forth from screen to text can produce visual strain. This is especially true if the display has light letters on a dark field, the reverse of print on most documents. In addition, eyestrain is caused by too much light in the visual field of the operator and by reflections on the screen. Finally, very low humidity can lead to eye irritation. The REFERENCES contain more information on vision effects (5-8).

VDT operators frequently complain about muscle aches and pains. Complaints are most often related to the neck, shoulders, back and wrists. Complaints mentioned less often involve the arms, hands and legs. Research indicates musculoskeletal symptoms are more frequently reported by VDT operators than by workers in traditional office jobs. This is probably due to the additional constraints of working with both keyboard and screen. General reviews of muscular pains in relation to workstation design may be found in the REFERENCES (4, 9-11).

Muscle aches and pains are common to many sedentary jobs. Because the body is designed for movement, a fixed position is more tiring than moderate movement. When the body is still circulation is slowed and as a result fewer nutrients are delivered to the muscles, and fewer wastes are removed from

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the muscles, blood vessels and spinal discs. The result can be muscular pain and, in some cases, injury. Thus, even in optimal postures, long periods without movement are physically stressful. When workstations are poorly designed, posture is poor, strains are placed on particular groups of muscles, and discomfort is increased. Some of the most common workstation pitfalls are described below:

- a chair without proper lumbar support will encourage a slumped posture, leading to low back pain;
- a chair and keyboard which are not height adjustable to allow a neutral-wrist position will force the wrists to flex or extend, which can lead to tendonitis and carpal tunnel syndrome;
- reflections on the screen can cause an operator to duck or twist to read the screen, leading to neck and back aches;
- too much light in the operator's eyes can tire the eyes and wash out the screen contrast;
- holding the head to the side to read a poorly positioned document may lead to neck and shoulder fatigue and pain;
- reaching forward with the arms to type on a poorly placed keyboard will add to neck and shoulder pain.

A diagram showing the elements of a good workstation is shown in Figure 1.

Operator work practices can also affect muscle pain. Hunching the neck forward, for example, can cause pain down the outside of the arm. Striking the keys with excessive force or tensing muscles more than necessary can tire them and lead to pain.

Many job stresses often associated with VDT work have been identified. Psychological stress can worsen the effects of physical stresses, by causing muscles to tense more, or by leading to increased headaches and fatigue. These stresses include excessive workload or work pace, machine monitoring, not enough job control, or minimal decision-making, job insecurity and lack of social supports. Job stress and some ways of alleviating it are discussed in Appendix A.

Concerns about reproductive risk have been raised by several clusters of miscarriages and birth defects among VDT operators (1, 11). Studies to date (12) have been inadequate to confirm or disprove a reproductive hazard. Three possible causes of potential reproductive problems have been suggested: radiation, psychological stress and awkward work postures. Reproductive risk and radiation will be discussed in Part II of these Guidelines, when it becomes available.

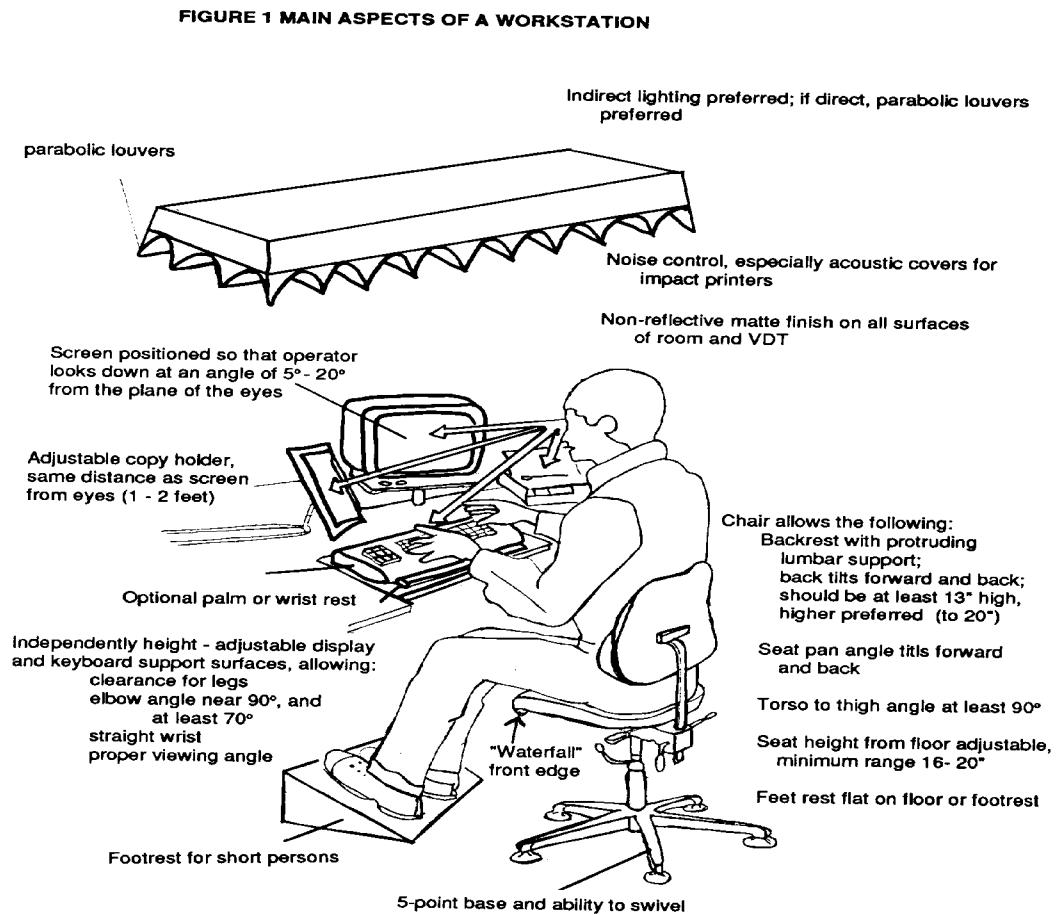
Other VDT Guidelines and Regulations

Several countries recognize the importance of providing a healthful work environment for operators of VDTs. Sweden and Germany, for example, have ordinances governing workstation design, office illumination, vision care and breaks. Australia has guidelines regulating some aspects of VDT use, and Australia and France each have ordinances which require medical screening of VDT operators. Some international standards are included in Reference 14.

In the United States, many states have VDT ordinances, guidelines or executive orders. Some employers in the private sector have introduced improvements or guidelines for VDT work.

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FIGURE 1 MAIN ASPECTS OF A WORKSTATION



WORK ENVIRONMENT

Scope of Section: **This section applies to all VDT workstations.**

A. Lighting and Glare

1. Less light is needed for VDT tasks than for other types of office work because of the illuminated display. Light requirements vary with the task. For example, the least light is needed when the operator has to look only at the VDT screen, and the most light is needed when documents are used which are difficult to read. Thus, the visual tasks required should be considered in determining appropriate illuminance levels. Room lighting should be only as bright as necessary for all tasks done in the room. For instance, typical lighting in a non-VDT office is 700 - 1000 lux. Illuminance can be measured with an easy-to-use inexpensive light meter, in the cost range of \$70 to \$100.

SPECIFICATION: Illuminance should be between 200 and 700 lux (approximately 20 to 70 footcandles), measured at the horizontal surfaces of any VDT workstation. More than 500 lux may be needed to read poor quality documents; if no hard copy is used, less than 500 lux is usually desirable. In rooms with lower light, lighting should be available to raise the illumination to at least 500 lux for cleaning and maintenance tasks.

2. Individual low-glare task lights should be available to each operator whose VDT work includes reading documents. The lights should be adjustable by the operator in three dimensions so that they can be positioned to illuminate documents and avoid creating glare on the screen, including the screen of a nearby operator.

Parabolic Louvers Light is reflected down in a path close to vertical irrespective of angle of incidence. No light can be seen from wide angles and glare is reduced considerably.

Baffles Glare is reduced by blocking light emitted at high angles. A similar effect is obtained by recessing fixtures.

Indirect Lighting Light is diffused off ceiling. Direct glare from lamps is eliminated but entire ceiling may cause reflections in VDT screens.

Screens Direct glare is reduced by blocking out light from luminaires and windows in areas most likely to cause glare.

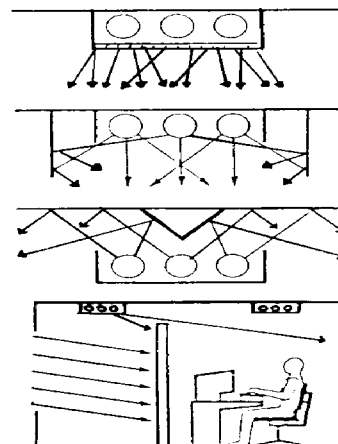


FIGURE 2 VDT LIGHTING

WORK ENVIRONMENT

3. Indirect room lighting is preferred. Such lighting shines onto the walls or ceiling and is reflected from these surfaces. If direct lighting is used, room light fixtures may need to be retrofitted with fewer or lower wattage bulbs. Louvers should be used which direct the light downward, so as to avoid images of light fixtures in VDT screens. Parabolic louvers are the preferred type. Alternatively, baffles or partitions can be installed which block light from a light fixture from reaching a workstation. A diagram of various solutions is shown in Figure 2.
4. Workstations and light fixtures should be oriented so that a seated operator has no bright light source (such as a room or task light or a window) in his/her field of vision while viewing the screen. In addition, bright light sources behind the operator, which produce glare or reflections on the screen, should be avoided. It is better to have workstations oriented with VDT screens perpendicular to windows, rather than arranged so that windows are in front of or behind the operator.
5. Windows should be fitted with blinds, drapes or shades capable of redirecting or blocking light; louvered blinds are preferred, as they redirect light without eliminating the view. Such window treatment may be required even when workstations are oriented with screens perpendicular to windows, if window light is excessive during certain parts of the day.
6. Additional methods of reducing glare include:
 - Painting walls with non-glossy matte-finish paints.
 - Substitution of a VDT with another VDT which has a screen with an anti-glare treatment, or retrofitting the existing VDT with such a screen.
 - If the above options do not eliminate glare, an anti-glare filter which fits over the VDT may be used. Filters for the purpose of glare reduction should be considered only when it is not possible to adequately decrease the source of glare. The employer should, however, provide a glare filter to operators who request them. It should be noted that some models of glare filters also block the electrostatic field, and, to some degree, the low frequency electric radiation. A table comparing various types of glare filters may be found in Appendix C.
7. Room and task lighting should be free of flicker.

B. VDT Exhaust

VDTs should be oriented so that forced-air exhaust is not directed toward any operator.

C. Noise

Impact printers in areas normally occupied by employees should be provided with acoustic covers or other equally effective devices.

VDT DESIGN

Scope of Section: **This section applies to all newly purchased VDTs.**

A. New Terminals

The employer should ensure that all newly purchased VDTs are in compliance with the provisions of ANSI/HFS 100-1988 Section 6 Visual Display and Section 7 Keyboards. Copies of ANSI/HFS 100-1988 can be obtained from the Human Factors Society, P.O. Box 1369, Santa Monica, CA 90406.

B. Adjustability

All VDT terminals should be adjustable for tilt and be capable of swivelling so that operators can adjust the screen position to suit a comfortable work posture. Additionally, operators should be able to vary the screen's position when they vary their work posture. Note: This function can be accomplished by means of a VDT stand or a VDT caddy (flexible arm which attaches to a table and supports the VDT monitor).

C. Surfaces

All exposed surfaces of the VDT should be finished in a neutral color with a non-reflective matte finish to minimize bright color and glare from these surfaces.

VDT WORKSTATION EQUIPMENT

Scope of Section: **This section applies to all VDT workstations.**

A. New and Existing Furniture

The employer should ensure that all newly purchased chairs and tables, for VDT use, comply with these Guidelines. Existing furniture should be brought into compliance by retrofitting or replacement in so far as possible. Examples of retrofitting are given in appropriate sections below.

B. Purchasing New Furniture

The purpose of the specifications below is to provide operators with comfortable furniture which will minimize stresses. Employers are urged to implement the furniture guidelines in a thoughtful manner, as described by the following paragraphs:

1. It is recommended that employers phase in improvements in a prioritized manner. In purchasing new furniture, highest priority should be given to those workstations used by operators who work four or more hours per day on a VDT, those experiencing visual or musculoskeletal symptoms, and those whose work, such as data entry work, is highly intensive. High intensity work is that which requires continuous reading of screen or text, or continuous high-speed keying.
2. The ANSI standard was developed using measurements, published in 1978, on people from a North American population, including people ranging in size from the 5th percentile female to the 95th percentile male in that population. As a result, these measurements are largely but not perfectly applicable to North Americans. When VDT operators include people larger or smaller than the range of the reference population, employers should consider purchasing equipment with even larger ranges of adjustability than specified, or purchasing more than one size of chairs and tables.
3. Whenever possible, invite operators to try out a variety of compliant chairs or tables as they work, for a few hours for each piece of furniture. Be sure they are first instructed in furniture adjustment. The best chair can be uncomfortable if it is not adjusted to fit the user's body. Then use their input as a major consideration in purchasing choices. It would defeat the purpose of the Guidelines to buy, for example, the least expensive compliant chair if operators find it uncomfortable. In addition, worker morale usually is improved by the opportunity to have input into working conditions.
4. It should be noted that different manufacturers may have differing methods of measuring, resulting in variations of a one half to one inch. It is, therefore, acceptable to choose a chair or table which is an inch or a few degrees of angle out of compliance for one or two specifications, if the chair has all the desired features and is accepted by employees.

VDT WORKSTATION EQUIPMENT

C. Chairs

Chairs for VDT use should meet the specifications below. The specific dimensions recommended in this section were adapted from the ANSI standard for VDT workstations (ANSI/HFS 100-1988). Table 1 compares the chair and table requirements of the Guidelines to those of the ANSI standard. Appendix E contains a checklist to aid in evaluating chairs.

TABLE 1
COMPARISON OF PEOSH REQUIREMENTS
AND THOSE OF ANSI FOR CHAIRS AND TABLES

PARAMETER	ANSI/HFS 100 - 1988 REQUIREMENT RECOMMENDATIONS		PEOSH GUIDELINES
CHAIRS			
Seat Width	min. 18.2"		min. 18"
Seat Depth		15 - 17"	15 - 18"
Compressed Seat Height	16 - 20.5"		Adjustability includes 16 - 20.5"
Seat Tilt		If adjustable, should include 0 -10 degrees back; if fixed, should be 0 - 10 degrees	Adjustable min. 8 degrees back (10 degrees preferred), max. 5 degrees forward
Seat Edge (waterfall)	For depth >16", design to provide relief to back of knee	For all chairs	Should have
Lumbar Support Contour -- Vertically Convex -- Horizontally Concave		Recommended	Should be Should be
Lumbar Support Height		6 - 9"	6 - 9"
Lumbar Support Width		min. 12"	min. 12"
Backrest Height		Should be appropriate for operations posture, task, preference. If tilt is >15 degrees, backrest should be high enough to support neck & head	min. 13" (16 - 20" preferred)

VDT WORKSTATION EQUIPMENT (Table 1 continued)
Chairs (Cont.)

PARAMETER	ANSI/HFS 100 - 1988 REQUIREMENT	RECOMMENDATIONS	PEOSH GUIDELINES
Seat to Lumbar Height Range		Fixed or adjustable within 6 - 10" range	Fixed or adjustable within 6 - 10" range
Seat Back Tilt	If fixed, angle 90 - 150 degrees. If adjustable, shall include some part of range 90 - 105 degrees.		Adjustable 85 degrees to at least 100 degrees (to 130 degrees preferred) maintaining at least a 90 degree sitting angle
5 Legs			Should have
Ability to Swivel			Should have
Non-slip Upholstery		For seats which tilt forward	Should have
Moisture Absorbent Upholstery			Should have
Adjustments Without Tools	Controls do not pose safety problems or violate clearance requirements	Convenient; designed to encourage use and rationally placed considering tasks and adjacent furniture	Should have
TABLES Independently Adjustable Surfaces			Should have
Width	min. 20"	24"	min. 20" (24" preferred) should allow room for task
Depth at Knee	min. 15" if fixed; 12.2" - 15" if adjustable		min. 15"
At Toe	23.5" if fixed; 18.7" if adjustable		min. 23.5"
Height to Top of Keyboard Support Surface	23.28" if adjustable, If fixed, *		Adjustability includes 23 - 28"
Display Surface Height	Permit entire viewing area of display to be 0-60 degrees below eyes plane. If adjustable for height, 5" range		Allow viewing angle of 5-30 degrees to center of screen.

* These requirements include user body position criteria, which can only be met by selection of all the workstation components, and by taking into consideration the smallest and largest members of the operator population.

VDT WORKSTATION EQUIPMENT

Chairs (Cont.)

1. The seat height of chairs should:

- allow the operator to place feet firmly on the floor or on a footrest.

EXPLANATION: Dangling legs put demands on lower back muscles.

- in combination with the work surface heights, allow the operator to achieve both a suitable keyboard-to-forearm relationship and adequate leg clearance. The forearm should be parallel to the floor, or held with the hand higher than the elbow. The wrist should be flat, that is, in the same plane as the forearm.

EXPLANATION: A flat wrist is very important. A flexed or extended wrist causes pressure on the median nerve as a person types, which can lead to carpal tunnel syndrome.

- be adjustable by the operator from a seated position without tools.

SPECIFICATION. Compressed seat height: the minimum range of adjustments should be 16.0 to 20.5 inches. This measurement is from the floor to the Seat Reference Point (see Glossary and Appendix B).

FIGURE 3 DIMENSIONS AND ADJUSTMENT RANGES OF CHAIRS

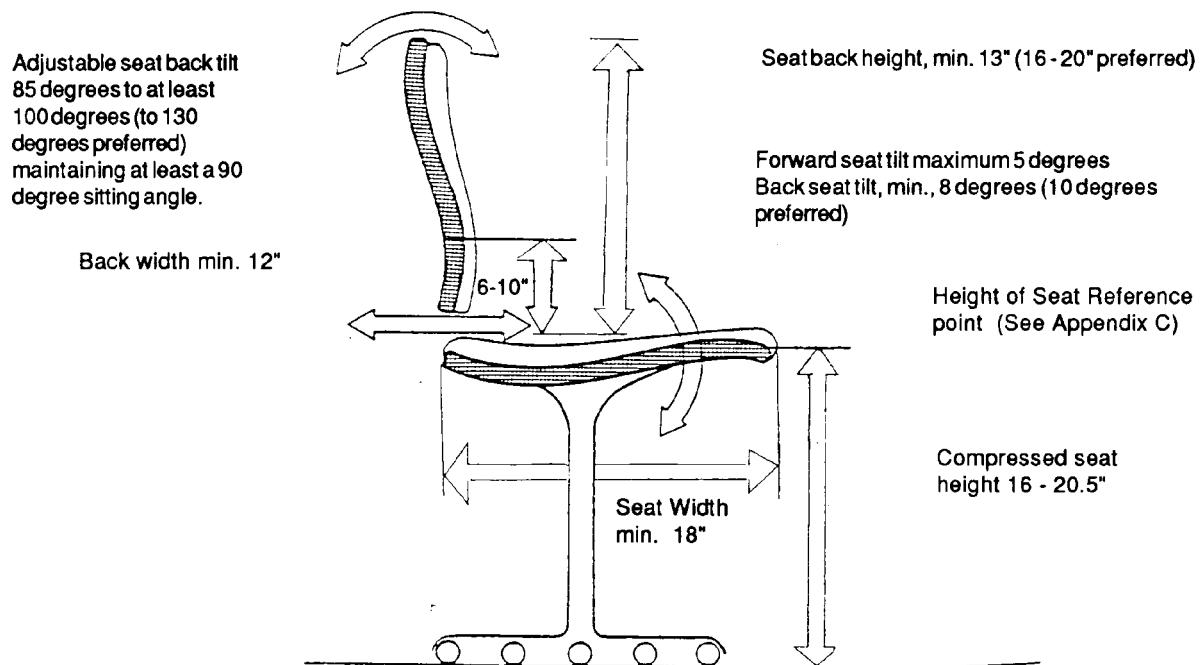


FIGURE 3 DIMENSIONS AND ADJUSTMENT RANGES OF CHAIRS

adapted from:
Kroemer, K, "VDT Workstation Design," in Handbook of
Human Computer Interaction, M. Helander (ed), Elsevier, 1988